Space Weather Technical Forecast

Issued on Wednesday 16 October 2024 at 01:18 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight Chance G1 Minor Geomagnetic Storm early day 1 (16 Oct), and perhaps from later day 3 (18 Oct). Ongoing Chance of further M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with several M-flares observed through the period, giving a peak flare of M2.1 at 15/1833 UTC from AR3854.

There are currently eight numbered sunspot regions on the Earth facing disc, with a new small un-numbered region having also emerged in the southeast quadrant. AR3852 and AR3854 in the southwest quadrant form a coupled pair of sunspots and are the most prominent spot groups on the disc, being responsible for the majority of flare activity. Both spot groups have shown small changes in evolution, however AR3854 has seen further small lead/intermediate spot emergence. Other numbered spot groups are small and magnetically simple.

A number of CMEs have been observed in available imagery, however these are all off the Earth-Sun line, and not thought Earth-directed.

Solar Wind / Geomagnetic Activity: Solar winds were in the range 390-450km/s, with a slight decreasing tendency. Density was mainly at average levels. The Interplanetary Magnetic Field (IMF), Bt, was predominantly weak, with the Bz component ranging from +/-8nT. Phi angle was positive (Away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background to Moderate with peak 465 pfu at 15/1810 UTC. The associated 24-hour fluence was below the Active. The 16/0000UTC observation was 7.79e6 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Further Moderate activity is expected with a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: Ongoing slightly elevated solar winds and residual weak CME influence are expected to gradually ease during the first half of day 1 (16 Oct). There is then the potential for elevated winds to develop from later on day 3 (18 Oct) into day 4 (19 Oct), due to a coronal hole enhancement in association with the large CH80/+.

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Overall, geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a likelihood of Active intervals both to start and end the forecast associated with possible glancing CME effects or coronal hole influence, and there is a slight chance of isolated G1 Minor Storm intervals day 1 (16 Oct) and days 3 and 4 (18 and 19 Oct).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES-18 is now largely at background, but there remains a slight chance of further enhancements given any significant flares. High energy electron flux may rise as solar winds ease and the Van Allen belts expand outward again. This brings a chance of High flux, although tempered by any possible CME effects or fast wind onset. The associated 24 hour fluence is expected to rise, but thought most likely to remain below Active (1e8 total pfu).

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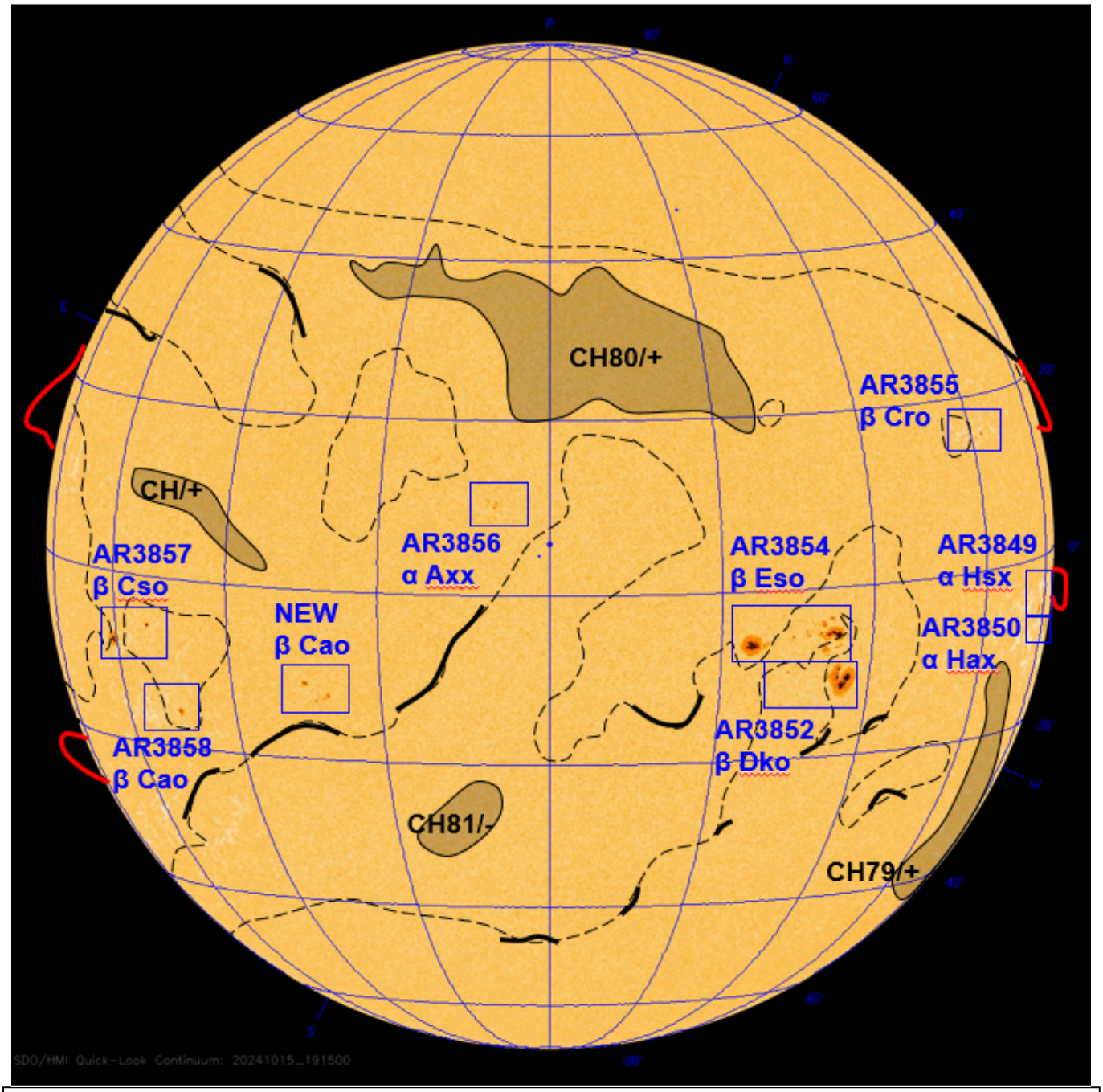
Figure 1: Solar Synoptic Analysis Valid 15/1930 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There remains one potential Earth glancing CME in the forecast. This originated from an M2.1 flare from AR3854 in the east disc, with a glancing impact still possible early on day 1 (16 Oct). The arrival time of this feature is low confidence, due to limited imagery for analysis, and may have already passed the near Earth environment as a weak feature.

Ongoing slightly elevated solar winds and residual weak CME influence are expected to gradually ease during the first half of day 1 (16 Oct). There is then the potential for elevated winds to develop from later on day 3 (18 Oct) into day 4 (19 Oct), due to a coronal hole enhancement in association with the large CH80/+, currently straddling north centre disc, with leading edge around 10 west. This feature is significantly larger and more clearly defined than the previous rotation, and an increase in solar winds towards slightly elevated to elevated speeds looks likely by the end of the period.

MOSWOC ENLIL output is providing limited guidance. Currently over-estimating the extent of the fast wind from the southern disc, and has little signal for CH80/+ later in the period. This likely due to current limitations with GONG H-alpha imagery that is used for the initialisation of the model.

Overall, geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a likelihood of Active intervals both to start and end the forecast associated with possible glancing CME effects or coronal hole influence, and there is a slight chance of isolated G1 Minor Storm intervals day 1 (16 Oct) and days 3 and 4 (18 and 19 Oct).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	10	1	10	20
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
12/0102	Nil	AR3854	27E 01S	480	Early 15 Oct	Low confidence. Glancing impact at most.

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Radio Blackouts - X-Ray Flares

There are currently eight numbered sunspot regions on the Earth facing disc, with a new small un-numbered region having also emerged in the southeast quadrant. In addition, ex-AR3848 beyond the west limb will continue to contribute to the flare risk in the short term. AR3852 and AR3854 in the southwest quadrant form a coupled pair of sunspots and are the most prominent spot groups on the disc, being responsible for the majority of flare activity. Both spot groups have shown small changes in evolution, however AR3854 has seen further small lead/intermediate spot emergence. Other numbered spot groups are small and magnetically simple.

Solar activity has been Moderate with several M-flares observed through the period, giving a peak flare of M2.1 at 15/1833 UTC from AR3854. Further occasional Moderate flares are expected, with an ongoing slight chance of an isolated X-class flare.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	Yes	40	35	35	35
Very Active	R3-R5 (X Class)	No	5	5	5	5

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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at background, but there remains a slight chance of enhancement given any notable flares, primarily from AR3848 in the near term from over the western limb, but also from AR3852/54 now located in the western portion of the disc.

Any significant enhancement will bring a slight chance of exceeding the S1 Minor Radiation Storm threshold.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES-16 have been at background to moderate levels. As solar winds ease, flux may rise at GEO to become Moderate to High. However, this is low confidence, especially with further potential glancing CME effects into the start of the period or possible high speed stream onset from later day 3 (18 Oct). Any such enhancement is likely to suppress flux at GEO to background levels again.

The associated electron fluence is therefore expected to be below the Active level (1e8 total pfu), but with a possible rising trend into days 2 and 3 (17 and 18 Oct). MOSWOC REFM model output is viewed as reasonable guidance at present.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	10	20	30	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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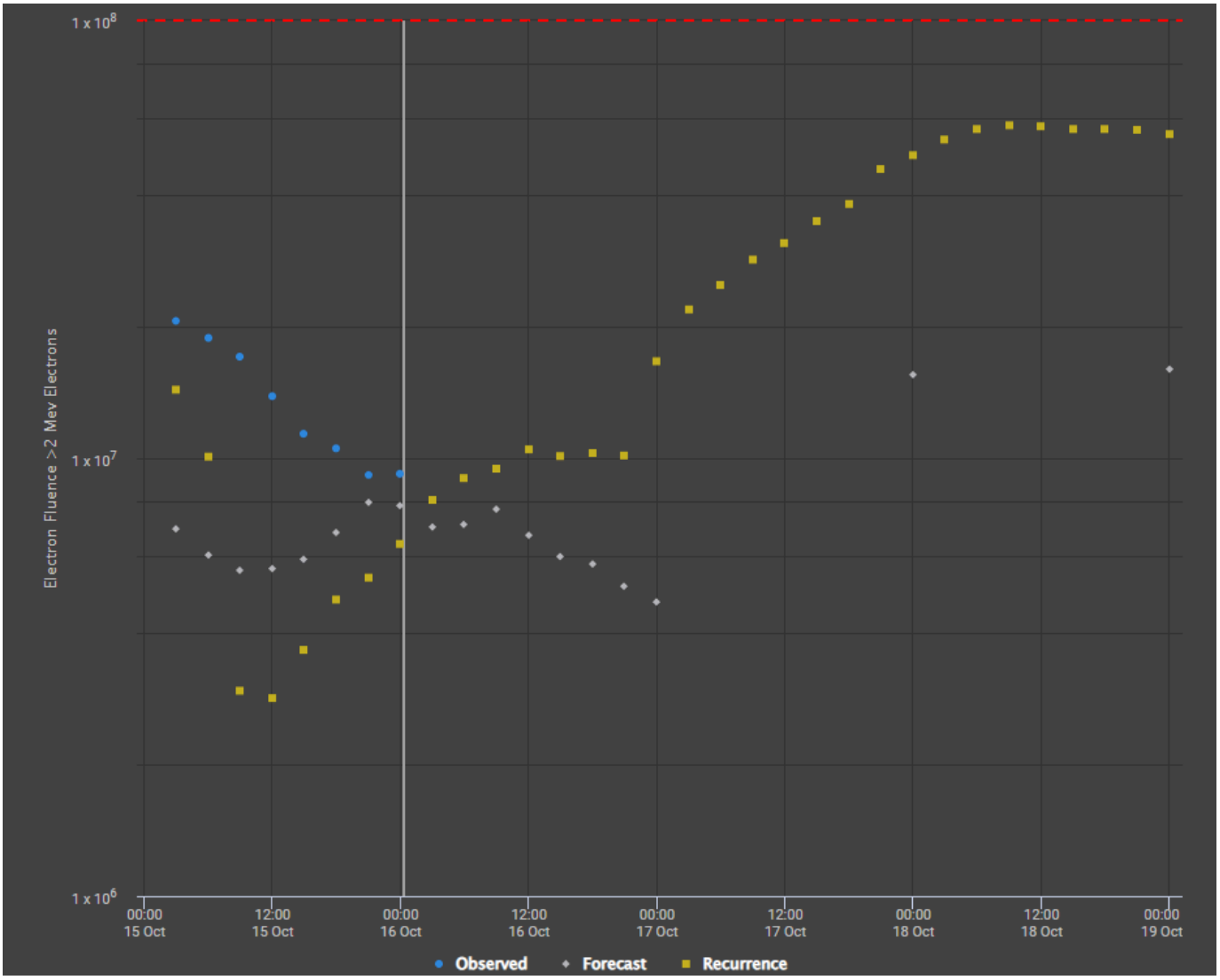
Figure 2: Latest MOSWOC REFM output



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